



# **Agilent N9330B Handheld Cable & Antenna Tester**

## **User's Guide**



**Agilent Technologies**

# Notices

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## Software Revision

This guide is valid for A.01.00 revisions of the Agilent N9330B Handheld Cable & Antenna Tester firmware.

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A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

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A **WARNING** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a **WARNING** notice until the indicated conditions are fully understood and met.

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### Documentation Conventions:

1. A pair of curly brackets { } indicates a softkey, for example {Start} refers to the Start softkey.
2. A pair of square brackets [ ] indicates a hardkey, for example, [ENTER] refers to the ENTER hardkey.
3. "DUT" refers to a device under test.



Agilent N9330B  
Handheld Cable & Antenna Tester

# 1 Overview



### Introduction

Agilent has designed the N9330B handheld cable and antenna tester (25 MHz to 4 GHz) to simplify the job of installing and maintaining cable and antenna systems. In addition to measuring SWR, Return Loss and Cable Loss, the N9330B also performs Distance-to-Fault (DTF) measurements that assist in determining cable defect locations. It is also useful in identifying maintenance necessary to maintain peak performance of your cable and antenna systems.



### Basic measurement functionality

Basic measurement functionality of the N9330B includes:

- SWR
- Return loss
- Cable loss
- DTF (SWR and return loss)

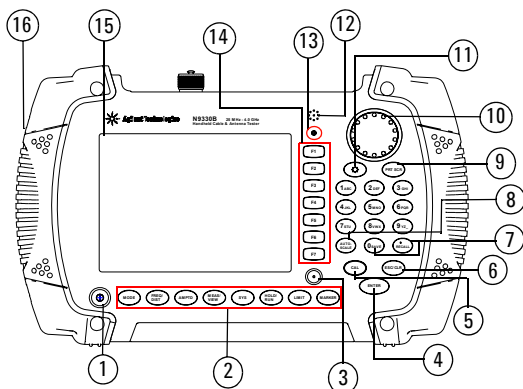


## Optimized Usabilities

The Agilent N9330B has the following features:

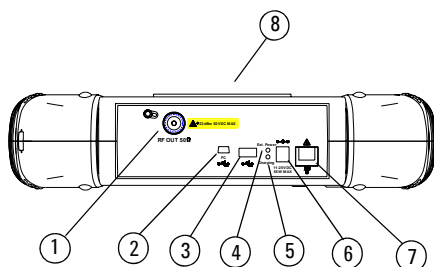
- 6.5-inch TFT colorful LCD screen (640 × 480 pixels) enables you to read the scans easily and clearly outdoors.
- Rechargeable lithium-ion battery supports a minimum of four hours continuous operation when fully charged.
- Print screen button for quick screen capture and easy file saving onto the memory stick.
- Auto file naming makes editing file names fast and easy.
- The light sensor adjusts the display brightness according to the environment to save power.
- USB interface for easy and fast file saving to PC or memory stick.
- User definable power saving mode.
- Back-lit keys make you find the right keys in darkness easily.
- Arc-shaped handles and a rugged rubber casing ensure a comfortable and firm hold.

## Front Panel Overview



|    | <b>Caption</b>       | <b>Brief Description</b>   |
|----|----------------------|--|
| 1  | Standby switch       | Turns the tester On or Off   |
| 2  | Function hardkeys    | Including hardkeys: Mode, FREQ/DIST, AMPTD, MEAS/VIEW, SYS, Hold/Run, Limit and Marker |
| 3  | Preset hardkey       | Returns the tester to a known state  |
| 4  | Enter hardkey        | Confirms a selection or configuration  |
| 5  | CAL hardkey          | Enters a calibration procedure   |
| 6  | ESC/CLR hardkey      | Escapes from a procedure or clears characters or numbers                               |
| 7  | Save and Recall keys | For file operation   |
| 8  | Auto scale hardkey   | Sets the amplitude borders automatically   |
| 9  | Print screen hardkey | For quick screen capture   |
| 10 | Knob                 | Selects an option or edits a number  |
| 11 | Brightness hardkey   | Adjusts the screen brightness  |
| 12 | Buzzer               | Beeps differently on different actions   |
| 13 | Light sensor         | Adjusts brightness automatically   |
| 14 | Softkeys             | Indicates current menu functions   |
| 15 | Screen               | Displays measured traces and status  |
| 16 | Strap handle         | For hand carry   |

## Top Panel Overview



| Caption                           | Brief Description   |
|-----------------------------------|---|
| 1 RF Output Connector (N-type)    | Outputs swept signal to DUT   |
| 2 USB interface Type B (Host)     | Connects to a PC  |
| 3 USB interface Type A (Device)   | Connects to a USB memory stick  |
| 4 LED indicator                   | Lights (On) when external DC power is connected to the tester   |
| 5 LED indicator (Charging)        | Lights (On) when the battery is charging  |
| 6 External DC power connector     | Connects to external DC power, for use with either the AC-DC charger-adaptor or automotive 12V DC adapter |
| 7 LAN interface                   | Reserved for future expansion   |
| 8 Tilt Stand (rear of instrument) | Allows user to lean instrument back for better viewing when placed on flat surface                        |

### Instrument Markings



The CE mark shows that the product complies with all relevant European Legal Directives (If accompanied by a year, it signifies when the design was proven).



The CSA mark is a registered trademark of the Canadian Standards Association.



The C-Tick mark is a registered trademark of the Australian Spectrum Management Agency.



This symbol is an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 4)



The instruction manual symbol: indicates that the user must refer to specific instructions in the manual.



The standby symbol is used to mark a position of the instrument power switch.



The symbol indicates this product complies with the **WEEE Directive** (2002/96/EC) marking requirements and you must not discard this equipment in domestic household waste. Do not dispose in domestic household waste. To return unwanted products, contact your local Agilent office, or refer to <http://www.agilent.com/environment/product/>



Agilent N9330B  
Handheld Cable & Antenna Tester

## 2 Getting Started



### Checking the Shipment

Check the shipment and order list when you receive the shipment.

- Inspect the shipping container for damages. Signs of damage may include a dented or torn shipping container or cushioning material that indicates signs of unusual stress or compacting.
- Carefully remove the contents from the shipping container, and verify if the standard accessories and your ordered options are included in the shipment.

For any question or problems, contact Agilent Technologies for consultant and service at:  
<http://www.agilent.com/find/assist>

## Safety Considerations

Agilent has designed and tested the N9330B in accordance with IEC Publication 61010-1:2001 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, and the tester is supplied in a safe condition. The N9330B is also designed for use in Installation Category II and pollution Degree 2 per IEC 61010 and IEC 60664 respectively.

Read the following safety notices carefully before you start to use this tester set to ensure safe operation and to maintain the product in a safe condition.

**WARNING**

**Personal injury may result if the tester's cover is removed. There are no operator-serviceable parts inside. Always contact Agilent qualified personnel for service. Disconnect the product from all voltage sources while it is being opened.**

---

**WARNING**

**This product is a Safety Class I tester. The main plug should be inserted in a power socket outlet only if provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.**

---

**WARNING**

**Electrical shock may result when cleaning the tester with the power supply connected. Do NOT attempt to clean internally. Use a clean soft cloth to clean the outside case only.**

---

**WARNING**

**Danger of explosion if the battery is incorrectly replaced. Replace only with the same or equivalent type recommended.**

**Do NOT dispose of batteries in a fire. Do NOT place batteries in the trash. Batteries must be recycled or disposed of properly.**

---

## 2 Getting Started

### WARNING

**Always use the three-pin AC power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause personal injury and product damage.**

---

### CAUTION

The VxWorks operating system requires full conformity to USB 1.1 or USB 2.0 standards from a USB disk. Not all the USB disk are built that way. If you have problems connecting a particular USB disk, please reboot the analyzer before inserting the next.

Use USB disk in FAT or FAT32 format, with only one partition for data saving and loading with the tester.

---

### CAUTION

If left the battery in tester unused, a fully charged battery will discharge itself over time.

Never use a damaged or worn-out adapter or battery.

The charging process will be intermitted if the battery temperature exceed the safety value. This process will restart when the temperature declines.

If you are charging the batteries internally, even while the tester is powered off, the tester may become warm. To avoid overheating, always disconnect the tester from the AC adapter before storing the tester into the soft carrying case.

Temperature extremes will affect the ability of the battery to charge. Allow the battery to attain ambient operating temperature before use or charging.

Storing a battery in extreme hot or cold places will reduce the capacity and lifetime of a battery. Battery storage is recommended at 25 °C.

---

### CAUTION

Always power on the N9330B before connecting an electronic calibrator.

---

### CAUTION

The average continuous power input is limited not to exceed +23 dBm, DC voltage to 50 VDC. Instrument damage may result if these precautions are not followed.

---



## Environmental Requirements

Agilent technologies has designed this tester for use under the following conditions:

- Operating temperature:  
0 °C to 40 °C (using AC-DC adapter)  
-10 °C to +50 °C (using battery)
- Storage temperature: -40 °C to +70 °C
- Battery temperature: 0 °C to 45 °C
- Humidity: 85%  $\pm$  5%

## Electrical Requirements

This tester allows the use of either a lithium battery pack (internal), AC-DC adapter shipped with the tester, or optional Automotive +12VDC adapter for its power supply.

## Electrostatic Discharge (ESD) Precautions

This tester was manufactured in an ESD protected environment. This is because most of the semiconductor devices used in this tester are susceptible to damage by static discharge.

Depending on the magnitude of the charge, device substrates can be punctured or destroyed by contact or mere proximity of a static charge. The result can cause degradation of device performance, early failure, or immediate destruction. ElectroStatic charges are generated in numerous ways, such as simple contact, separation of materials, and normal motions of persons working with static sensitive devices.

When handling or servicing equipment containing static sensitive devices, adequate precautions must be taken to prevent device damage or destruction.

Only those who are thoroughly familiar with industry accepted techniques for handling static sensitive devices should attempt to service circuitry with these devices.

### Power Requirements

The AC power supplied must meet the following requirements:

---

|                   |                    |
|-------------------|--------------------|
| <b>Voltage:</b>   | 100 VAC to 240 VAC |
| <b>Frequency:</b> | 47 to 63 Hz        |
| <b>Power:</b>     | Maximum 63 W       |

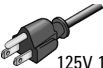


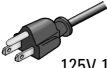

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The AC/DC power supply charger adapter supplied with the analyzer is equipped with a three-wire power cord, in accordance with international safety standards. This power cord grounds the analyzer cabinet when it is connected to an appropriate power line outlet. The power cord appropriate to the original shipping location is included with the analyzer.

Various AC power cables are available from Agilent that are unique to specific geographic areas. You can order additional AC power cords are correct for use in different areas. The AC Power Cords table provides a lists of the available AC power cords, the plug configurations, and identifies the geographic area in which each cable is typically used.

The detachable power cord is the product disconnecting device. It disconnects the main AC circuits from the DC supply before other parts of the product. The front-panel switch is only a standby switch and do not disconnect instrument from AC LINE power.

## AC Power Cord

| Plug Type   | Cable Part Number | Plug <sup>a</sup> Description | For use in Country & Region   |
|---|-------------------|-------------------------------|---|
| <br>250V 10A   | 8120-1703         | BS 1363/A                     | Option 900<br>United Kingdom,<br>Hong Kong,<br>Singapore, Malaysia      |
| <br>250V 10A   | 8120-0696         | AS 3112:2000                  | Option 901<br>Australia, New<br>Zealand                                 |
| <br>250V 16A   | 8120-1692         | IEC 83 C4                     | Option 902<br>Continental Europe,<br>Korea, Indonesia,<br>Italy, Russia |
| <br>125V 10A   | 8120-1521         | CNS 10917-2<br>/NEMA 5-15P    | Option 903<br>United States,<br>Canada, Taiwan,<br>Mexico               |
| <br>125V 10A   | 8120-2296         | SEV 1011                      | Option 906<br>Switzerland   |
| <br>230V 15A  | 8120-4600         | SABS 164-1                    | Option 917<br>South Africa, India                                       |
| <br>125V 15A | 8120-4754         | JIS C8303                     | Option 918<br>Japan   |
| <br>250V 16A | 8120-5181         | SI 32                         | Option 919<br>Israel  |
| <br>250V 16A | 8120-8377         | GB 1002                       | Option 922<br>China   |

# Working with Batteries

**CAUTION**

Full charge the battery before first using the analyzer.

## Installing a Battery



| Step                      | Notes  |
|---------------------------|--|
| 1 Open the battery cover  | Use a phillips type screwdriver, loosen the retaining screw, then pull the battery cover open. |
| 2 Insert the battery      | Observe correct battery polarity orientation when installing.                                  |
| 3 Close the battery cover | Push the cover closed, then re-fasten the cover with the retaining screw.                      |

## Viewing Battery Status

Determine the battery status in either of the following methods:

- Check the battery icon in the lower right corner of the front panel screen: it indicates the approximate level of charge.
- The LED on the battery indicates the remaining battery power.
- Press **[SYS] > {More} > {Status}** to check the current battery voltage.

## Charging a Battery

You may charge the battery both in the tester and in the external battery charger (option BCG).

**CAUTION**

Connect the automotive adapter to the IT power outlet of your automobile (with option 1DC) for battery recharging.

---

You may recharge the battery in the N9330B while the tester is operating or when it is turned off.

- 1 Install the battery in the tester.
- 2 Plug in the correct AC/DC adapter and switch external power on.
- 3 The green LED indicating external power and charging status lights should turn on, indicating that the battery is charging.

When the battery is fully charged, the green charging LED turns off.

During charging and discharging, the battery voltage, current, and temperature are monitored. If any of the monitored conditions exceed their safety limits, the battery will terminate any further charging or discharging until the error condition is corrected.

The charging time for a fully depleted battery, is approximately four hours.

### Your first 10 minutes with the N9330B


The N9330B is fitted with a TFT screen, which is viewable under all lighting conditions.

**CAUTION**

Do not apply excessive RF or DC signals to the tester RF OUTPUT connector. The maximum damage RF input level is +23 dBm (or  $\pm 50$  VDC signal input).

---

### Power on the N9330B

Pressing the  standby button switches on the tester. The tester then boots up and runs an internal self-test that includes the following items:

- internal temperature
- battery voltage (if battery powered)
- battery capacity (if battery powered)



← Using the tilt stand

## Preparation for Use

Use **[SYS]** hardkey to set or check the system settings of the tester.

### Setting up the N9330B

Press **{Power Manager}** to enable or unable the power saving mode.

Pressing **[SYS] > {Power Manager (On)}** turns off the LCD screen and key light after a pre-defined idle time set by pressing **{Power Manager} > {Edit}**.

Press **[SYS] > {More} > {More} > {Key Light}** to turn on or turn off the key light.

Press **[SYS] > {Language}** to select a language displayed on the screen.

Press **[SYS] > {Clock}** to set the time and date.

### Check system status

Pressing **[SYS] > {More} > {Status}** shows the primary information and current status of the tester.

## Making the first measurement

Four easy steps:

- 1 Select a measurement mode.
- 2 Set the desired measurement range, or select a frequency range from the list of signal standards.
- 3 Calibrate the tester.
- 4 Connect the DUT (Device Under Test) to the tester RF OUT connector being careful not to apply a signal which exceeds the maximum signal levels.

### Step 1. Selecting a measurement mode

Pressing **[MODE]** brings up a check box for you to choose a measurement mode from the following five modes:

- SWR (Standing Wave Ratio)

## 2 Getting Started

- Return loss vs. Frequency
- Cable loss
- DTF-SWR
- DTF-Return loss

### Example: selecting the return loss measurement

- 1 Press **[MODE]** to bring up the mode selection check box
- 2 Use the rotary control knob to select the Return Loss vs. Frequency
- 3 Press **[ENTER]** to confirm your selection.

A measurement mode indicator – **FREQ-RL** will be displayed in the top middle part of the screen.

See [“Selecting a Measurement Mode”](#) on page 24 for more information.

### Step 2. Setting a measurement range

Pressing **[FREQ/DIST]** brings up a submenu for setting the measurement range.

If you previously chose a frequency domain measurement, the submenu allows you to set the start and stop frequency, or select a pre-defined frequency range from the list of signal standards.

If you previously chose a DTF measurement, the submenu allows you to set the start and stop displayed distance, and other cable measurement related parameters.

### Example: setting a frequency range from 1 GHz to 2 GHz

- 1 Press **{Start} > [1000] > [ENTER]** to set the start frequency to 1 GHz
- 2 Press **{Stop} > [2000] > [ENTER]** to set the stop frequency to 2 GHz

The start frequency of 1000.0 (in MHz) displays at the left lower corner of screen, and the stop frequency 2000.0 displays at the right lower corner of the screen.



### Step 3. Calibrating the N9330B

The N9330B must be calibrated before making an actual measurement (SWR/Return loss/Cable loss/DTF) using the selected frequency span or the full span of the instrument. The N9330B offers two calibration modes:

- **FullSpan Cal**

Performs an Open-Short-Load calibration across the full frequency range. The tester allows you to modify the frequency range for measurement after the FullSpan Cal is performed.

- **SelectedSpan Cal**

SelectedSpan calibration is the default calibration mode. Performs an Open-Short-Load calibration across a user-defined frequency range. The tester requires re-calibration if the Selected Frequency Span is changed.

Key access: [SYS] > {Cal Mode}

#### Example: Performing a calibration

Assuming the Selected Frequency Span is from 1 to 2 GHz for return loss measurement and the T-combo calibrator tool is being used.

- 1 Press [CAL] to bring up a dialog box that will guide you through the calibration. The normal calibration order is open, short, and load.
- 2 Fasten the OPEN end of the T-combo to the RF OUT connector on the top panel of the tester, then press [ENTER] to initiate the open calibration.
- 3 Fasten the SHORT end of the T-combo to the RF OUT connector, then press [ENTER] to initiate the short calibration.
- 4 Fasten the LOAD end of the T-combo to the RF OUT connector, then press [ENTER] to initiate the load calibration.

To abort a calibration, press the [ESC/CLR] button.

For more details of calibration, please refer to "Calibrate the N9330B before making measurements" on page 25.

### Step 4. Connecting DUT to RF Output port

#### Example: Measuring return loss

Assuming you have completed the calibration procedure above. Refer to the following instructions to make a return loss measurement.

- Connect the cable under test to the RF OUT connector on the top panel of the tester.
- The tester immediately performs the measurement and displays a trace on the screen.

If further data analysis is necessary, refer to:

["Using Markers and Pass/Fail Limit Lines"](#) on page 36, ["Processing Traces"](#) on page 39.

## Contact Agilent Technologies

Agilent maintains sales and service offices around the world to provide you with complete support for your handheld cable and antenna tester. In any correspondence or telephone conversations, refer to your handheld cable and antenna tester by its product number and the full serial number.

Go to <http://www.agilent.com/find/assist> for help with:

- product selection, configuration, and purchases.
- technical application assistance, and consulting.
- rental options, and refurbished equipment.
- repair, calibration, education and training.

If you do not have access to the internet, call the appropriate number shown below. Or contact your local Agilent Technologies Sales and Service Office.

|                              |   |
|------------------------------|---|
| United States                | (tel) 800 829 4444<br>(fax) 800 829 4433  |
| Canada                       | (tel) 877 894 4414<br>(fax) 800 746 4866  |
| Latin America                | (tel) +1 (305) 269 7500   |
| China                        | (tel) 800 810 0189<br>(fax) 800 820 2816  |
| Korea                        | (tel) 080 769 0800<br>(fax) 080 769 0900  |
| Japan                        | (tel) +81 426 56 7832<br>(fax) +81 426 56 7840  |
| Taiwan                       | (tel) 0800 047 866<br>(fax) 0800 286 331  |
| Europe                       | (tel) +31 20 547 2111   |
| Australia                    | (tel) 1 800 629 485<br>(fax) +61 (3) 9210 5947  |
| Other Asia Pacific Countries | (tel) +65 6375 8100<br>(fax) +65 6755 0042<br>Email: <a href="mailto:tm_ap@agilent.com">tm_ap@agilent.com</a> |

## 2 Getting Started



Agilent N9330B  
Handheld Cable and Antenna Tester

## 3 Making Measurements

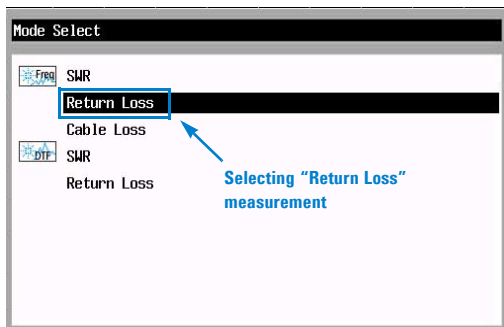



### 3 Making Measurements

## Selecting a Measurement Mode


Assuming you wish to make a return loss measurement, you need to:

- Press the [MODE] hardkey to call up the mode selection check box.
- Use the front-panel knob to select a measurement type from the Mode Select list.
- Press the [ENTER] hardkey to confirm your selection.



The icon  indicates the following frequency domain measurement:

- SWR
- Return loss
- Cable loss

The icon  indicates the following Distance to Fault (DTF) measurement:

- SWR
- Return loss

## Calibrate the N9330B before making measurements

Before making a measurement (SWR/Return loss/Cable loss/DTF) in a specified frequency range or the full span, you must calibrate your N9330B.

It is important to keep the calibration frequency range as close as possible to the actual sweep frequencies necessary for the measurements. Calibrating over a larger frequency range than the actual measurement range will reduce the accuracy of the test results. For example, using a 1 GHz calibration range when the measurement range is only few kHz.

Performing one calibration is acceptable provided the calibration frequency range selected incorporates all intended measurement frequencies. If the frequency span is changed, a new calibration must be performed for that measurement. A new calibration must be performed if any components used in the calibration setup are changed. For example, a short coaxial cable used to connect the tester to the DUT.

### Calibration Mode

The N9330B offers two calibration modes:

- **FullSpan Cal**

Runs an open-short-load calibration across the full frequency span (25 MHz to 4 GHz).

A FullSpan Cal ignores the frequency changes during measurements.

- **SelectedSpan Cal**

Performs an open-short-load calibration across a user-defined frequency span. A SelectedSpan Cal requires a re-calibration of the tester, after changing the measurement frequency range. Normally, the selected span should be set as close to the actual swept frequency range.

Key access: **[SYS] > {Cal Mode}**

### Types of Calibrators

Two types of calibrator tools are available from Agilent for use with the tester:

- **T-combo calibrator**

This is a T-shaped mechanical calibrator. It consists of a calibrated open, short and 50  $\Omega$  load. Using the T-combo calibrator will result in a more accurate calibration than when using the an Electronic calibrator.

- **Electronic calibrator**

The Electronic calibrator enables you to perform a one-step calibration process. It automatically performs an open, short, and 50 $\Omega$  load calibration. The Electronic calibrator is a faster but less accurate than when using a T-combo mechanical calibrator.



## Calibrating procedure introduction

Choose either the T-combo or the Electronic calibrator to perform a calibration process. Different combinations of calibration mode and calibrator may benefit the measurement accuracy differently. (Assuming the measurement resolution remains unchanged):

- Using SelectedSpan calibration mode and the T-combo calibrator provides a more accurate calibration.
- Selecting FullSpan calibration mode and electronic calibrator is the simplest, most convenient calibration.

The tester default setting is the SelectedSpan calibration mode. Agilent recommends using the SelectedSpan calibration mode for best results.

It is important to keep the calibration frequency range as close as possible to the actual sweep frequencies necessary for the measurements. Calibrating over a larger frequency span than the actual measurement range will reduce the accuracy. For example, using a 1 GHz calibration range when the measurement range is only few kHz.

### Calibrate with an electronic calibrator

**NOTE**

Never connect an electronic calibrator to the tester until *after* powering on the N9330B.

The tester needs about 35 sec. to record the data of an Electronic calibrator the first time a new Electronic calibrator is used with a specific tester.

After the initial use of an Electronic calibrator, the tester requires approximately 12 sec. to perform the automated open-short-load calibration.

### 3 Making Measurements

The Electronic calibrator performs an automatic, open-short-load consecutively:

- 1 Press **[CAL]** to bring up a dialog box for calibration guidance.
- 2 Connect the Electronic calibrator to the RF OUT connector on the top panel of the tester. Connect the USB cable between the electronic calibrator and the tester USB port. The correct USB cable is supplied with an Electronic calibrator.
- 3 Press **[ENTER]** to start calibration.

#### Calibrate with a T-combo calibrator

Using a T-combo calibrator is a three step process requiring the user to manually change the open-short-load components. The default order of the calibration process is open-short-load.

- 1 Press **[CAL]** to bring up the dialog box for calibration guidance.
- 2 Connect the “Open” component of the T-combo calibrator to the RF OUT connector of the tester. Press **[ENTER]** to start the open calibration.
- 3 Connect the “Short” component of the T-combo calibrator to the RF OUT connector of the tester. Press **[ENTER]** to start the short calibration.
- 4 Connect the “Load” component of the T-combo calibrator to the RF OUT connector of the tester. Press **[ENTER]** to start the load calibration.

A “Calibrated” indicator will be displayed on the upper left corner of the screen when the calibration is completed.

**Using User Cal Mode** A **User Cal Mode** is an optional selection when using a mechanical calibrator. The User Cal Mode allows the user to choose one cal standard from the open-short-load to perform a customized calibration.

For example, pressing **[CAL] > {User Cal Mode} > {Open}** initiates a calibration using the Open calibration standard only.

## Measuring Return Loss/SWR/Cable Loss

Return loss is the measurement of the signal reflection characteristics of a cable and antenna system. A return loss measurement is useful in detecting problems in the antenna feedline system and the antenna itself. A portion of the incident power is reflected back to the source from transmission line faults as well as from the antenna itself. The ratio of the reflected voltage to the incident voltage is called the reflection coefficient. The reflection coefficient is a complex number, meaning it has both magnitude and phase information. In S-parameter terms, return loss is referred to as an S11 measurement.

SWR and cable loss measurement derive from return loss measurement.

**NOTE**

Test signals can cause interference. When testing cables attached to an antenna, the test signal is radiated from the antenna. Verify that the signal used for the test CANNOT cause interference to other antennas.

### Perform a basic return loss measurement

When measuring return loss, SWR, or cable loss with your N9330B, follow the same operation procedure as shown below.

To make a return loss (versus. frequency) measurement over a frequency range of 50 to 400 MHz, perform the following steps:

- 1 Press the **[MODE]** hardkey to call up a measurement mode menu. Rotate the front-panel knob to select a measurement mode (for this example, Return Loss). Press the **[ENTER]** hardkey to confirm your selection. For more detailed information, refer to “[Selecting a Measurement Mode](#)” on page 24.
- 2 Press the **{Start}** softkey to call up the start frequency menu. Press **{50} > [ENTER]** to set the start frequency to 50 MHz.

## 3 Making Measurements

- 3 Press the **{Stop}** softkey to call up the stop frequency menu. Press **{400} > [ENTER]** to set the stop frequency to 400 MHz.
- 4 Press the **[CAL]** hardkey to call up the calibration process menu. Follow the instructions for performing the calibration. For more information about calibration, refer to [“Calibrate the N9330B before making measurements”](#) on page 25. A “Calibrated” indicator will be displayed on the upper left corner of the screen when the calibration is completed.
- 5 Remove the calibrator and connect the DUT to the RF OUT connector of the tester. The tester will then measure the return loss of the DUT.

### Adjusting the measurement resolution

The tester has three resolution settings, 521, 261, or 131 points. Press the **[MEAS/VIEW]** hardkey, then the **{Resolution}** softkey to choose the resolution setting desired, then press the **[ENTER]** hardkey to enter the selection.

The higher the resolution, the more accurate the measurement results. However, a higher resolution setting will require a longer sweep time.

### Using Marker/Limit

For further trace analysis, refer to:

[“Using markers”](#) on page 36.

[“Using Pass/Fail Limit Lines”](#) on page 37

[“Trace Operation”](#) on page 39.

For performing an isolated return loss measurement, refer to:

[“Using single sweep”](#) on page 48.

For minimizing the interference, refer to:

[“Enabling interference immunity”](#) on page 48.

## Measuring Distance to Fault (DTF)

For this measurement, an internally generated signal emits from the RF OUT port of the tester and is transmitted to the cable and antenna system (DUT). The tester receives and processes the signal power reflected from faults and imperfections.

In performing a DTF measurement, the tester uses frequency domain reflectometry. The transmitted and reflected signals contain information about the distance to the faults. This information is used to determine the physical distance to the faults. The tester displays the physical distance to the probable faults, corrected for cable loss and the velocity propagation factor of the cable.

### Perform a DTF measurement

To make a DTF-return loss measurement over a frequency range of 50 to 400 MHz, perform the following steps:

- 1 Press **[FREQ/DIST] > {Start} > 50 > [ENTER]** to set the start frequency to 50 MHz.
- 2 Press **{Stop} > 400 > [ENTER]** to set the stop frequency to 400 MHz.
- 3 Press the **[MODE]** hardkey to select a measurement mode. Rotate the front-panel knob to highlight and select the DTF-Return loss, and press **[ENTER]** to confirm your selection.
- 4 Press **[CAL]** to bring up the calibration process guidance. Follow the instructions to perform a calibration. For more information about calibration, refer to [“Calibrate the N9330B before making measurements”](#) on page 25.
- 5 Remove the calibrator and connect the cable under test (DUT) to the RF OUT connector on the top panel of the tester. The DTF measurement starts and the results are displayed on the screen. A peak in the horizontal trace indicates a defective location.

### 3 Making Measurements

For a more precise measurement, enter the cable loss and velocity factor information.

#### NOTE

The measured distance and the displayed distance can be different.

The measured distance refers to the distance the tester has measured according to the frequency ranges you specified. You can check the measured distance by pressing **{DTF Config}**

The displayed distance refers to that part of the entire measured distance chosen. The displayed distance may be manually set by pressing **[FREQ/DIST] > {Start}**, and **{Stop}**.

## Adjusting the measurement resolution

The tester has three resolution settings, 521, 261, or 131 points. Press the **[MEAS/VIEW]** hardkey, then the **{Resolution}** softkey to choose the resolution setting desired, then press the **[ENTER]** hardkey to enter the selection.

The higher the resolution, the more accurate the measurement results. However, a higher resolution setting will require a longer sweep time.

## Using Marker/Limit

For further trace analysis, refer to:

“Using markers” on page 36.

“Using Pass/Fail Limit Lines” on page 37.

“Trace Operation” on page 39.

For getting an isolated return loss signal, refer to:

“Using single sweep” on page 48.

For minimizing the interference, refer to:

“Enabling interference immunity” on page 48.

## Measured distance

It is not always understood how frequency range affects measured distance and resolution, and may appear counter-intuitive. This section is intended to help simplify understanding the DTF measurement.

In the following equations:

Resolution refers to the number of points that are measured and used in the displayed trace. Pressing **[MEAS/VIEW] > {Resolution}** enables you to change the resolution setting.

- $(V_t/V_c)$  refers to the velocity factor of a cable, its transmission rate relative to light. The velocity factor may be set by pressing **{Velo Factor}**.
- F2 and F1 refer to the stop and start frequency (MHz).

The measured distance (in meters) of a DTF measurement is determined by the following equation:

$$\text{Distance} = (\text{Resolution} \times 150 \times V_t/V_c) / (F_2 - F_1) \\ V_c = 3 \times 10^8$$

From this equation, you can adjust the measurement:

- To Increase the measured distance:
  - Increase the number of points, or
  - Reduce the frequency span.
- To decrease the measured distance:
  - Reduce the number of points, or
  - Increase the frequency span.

## **3 Making Measurements**





Agilent N9330B  
Handheld Cable & Antenna Tester

## 4 Using Functions



# Using Markers and Pass/Fail Limit Lines

Markers and limit lines are used for measurement trace analysis.

## Using markers

Markers are used to track the specified points on a trace. You may apply up to six markers and visually track up to six points on each trace. Each of the six markers has the following settings:

- **On**  
Activates a Marker and places a vertical, colored bar, with the Marker number ranging from M1 to M6 to the foot of the bar.
- **Off**  
Deactivates a marker and erases the Marker bar.
- **Edit**  
Brings up a dialog box and allows you to set the position of a marker.

### NOTE

Rotating the knob will move the position of a marker.

- **Marker to Peak**  
Places the active marker on the highest indicated value of the trace.
- **Marker to Minimum**  
Places the active marker on the lowest indicated value of the trace.
- **Delta**  
Is associated with the reference marker (Marker 1 is the default reference marker). Therefore, Marker 1 must be applied before creating the delta. Delta displays the value difference between the reference marker position and the delta marker position. Only one delta marker can be associated with a given reference marker.

### General steps for adding a marker

Take adding Marker 1 for example:

| Step  | Note  |
|---|---|
| 1 Press [ <b>Marker</b> ] hardkey to call up a submenu of markers   |   |
| 2 Press { <b>Mark 1</b> } softkey to enter a submenu of Marker 1    |   |
| 3 Press { <b>On</b> } softkey to activate Marker 1                  | Marker 1 sets its position refer to its previous position |
| 4 Press { <b>Edit</b> } softkey to set the position of the Marker 1 | Rotating the front-panel knob also positions the marker   |

## Using Pass/Fail Limit Lines

Limit lines will alert the user to a measurement that exceeds the upper limit value of a trace. Limits are set in dB, and define the location of the limit lines displayed on the screen.

The tester applies upper limits only. Limit lines are used as pass/fail indicators:

- If the amplitude of a measured trace is below the limit line, a green *Pass* indicator is displayed in the upper right corner of the screen.
- If the amplitude of a trace is above a limit line, a red *Fail* indicator is displayed in the upper right corner of the screen. A limit fail beep sound can be turned on for an additional trace fail indicator.

### Two types of limit lines

- Single limit  
A single limit value is applied over the full frequency range, 25 MHz to 4 GHz. A maximum of two single limit lines may be applied.

## 4 Using Functions

- Multiple limit segment  
After setting a limit segment, the limit line is valid only for your selected frequency/distance range and amplitude range. A maximum of five limit segments may be applied.

### Setting up a limit line

Refer to the following example to add a limit line.

**Example:** adding limit 1

| Step   | Note   |
|--|--|
| 1 Press <b>[Limit]</b> hardkey to access a submenu of limit settings.                                  |  |
| 2 Press <b>{Multi Limit}</b> softkey to access the multi limit segments submenu.                       | Use this feature if setting multiple limit values on a trace.      |
| 3 Press <b>{Limit 1}</b> softkey to access a submenu of the limit 1.                                   | choosing the specific segment number.                              |
| 4 Press <b>{On}</b> softkey to activate a limit line.  | This will set the limit line at previously configured limit value. |
| 4 Press <b>[Edit]</b> softkey to set the position of a limit line.                                     | To adjust the limit line to your specifications.                   |
| 5 Press <b>{Prev segment/Next segment}</b> to continue setting specifications for a multi-limit trace. | For multi limit traces.  |

## Processing Traces

Trace overlap and trace operation are used in the tester for post trace processing. Very useful in comparing measurements to identify differences and faults.

### Trace Operation

Trace operation mathematically adds or subtracts the current measured trace to a previously saved trace. This will provide information that may indicate when a cable or antenna system is degrading in performance and would require maintenance.

#### NOTE

The previously saved trace must have the same setup, with consistent measurement parameters as the current trace. For example, the same mode, resolution, and frequency/distance range.

**Example:** A saved a trace (data) has been entered into the local memory of the tester. The trace was measured under return loss mode in GSM full band (880 MHz to 960 MHz), with 521 data points.

Perform the following steps for a trace operation:

- 1 Press **[MEAS/VIEW] > {Trace Operation}** to access the check box for selecting a math operation mode:
  - Trace – Memory  
Current active trace mathematically subtracts the trace from local memory of the tester.
  - Trace + Memory  
Current active trace mathematically adds the trace from local memory of the tester.
- 2 Rotate the knob to select a mode and press **[ENTER]**.
- 3 The tester brings up a list of existing trace data in the local memory the tester.

## 4 Using Functions

- 4 Rotate the knob to select a trace that has the same measurement mode, resolution and frequency range, and press **[ENTER]**.

The tester displays the mathematically calculated trace on its screen.

### Trace overlap

The tester allows a previously saved trace to be recalled onto the currently displayed screen. The two displayed traces are identified by different colors.

Trace overlap is a real-time tool for quick comparisons between the current trace and a previously saved trace. The tester cannot save the overlaid traces into either local memory or external USB memory stick.

#### NOTE

The previously saved trace must have consistent measurement parameters with the current trace. For example, the same mode, resolution, and frequency/distance range.

**Example:** To compare the current measurement trace to a saved trace (data) in the local memory of the tester. They were both measured in the return loss mode, GSM full band (880 MHz to 960 MHz), resolution 521 points.

Perform the following steps to do a trace overlap operation:

- 1 Press **[MEAS/VIEW] > {Trace Overlap} > {Select Trace}** to display a list of trace data stored in the local memory of the tester.
- 2 Use the front-panel knob to select a trace and press **[ENTER]**.

The tester will display the saved trace, while continuously making measurement of the DUT (current measured trace). The two traces are displayed on the screen simultaneously:

- Trace one is displayed as a static trace and is green in color. It is the saved trace results recalled from the local memory of the tester.
- Trace two is yellow in color and is repeatedly scanned. It is the currently measured trace result.

### Saving and Recalling a file

N9330B allows you to save trace data, instrument setups, or the displayed screen graphic information into the local memory of the tester. With a USB memory stick inserted, you can also save trace data and screen copies into an external memory devices.

| File               | Format | Max. # (Internal memory) |
|--------------------|--------|--------------------------|
| Trace data         | *.data | 200                      |
| Instrument setting | *.data | 15                       |
| Screen copy        | *.jpg  | Stored onto USB disk     |

Trace data includes both the measurement data and the instrument setup information. Trace data and instrument setup files are saved with a “.data” file extension.

### Save a trace data

Trace data includes the measured data and the current instrument setups. Save Data does not include limit lines. Limit lines can be saved using the Save Setup feature.

- Pressing [**Save**] > {**Save Data**} allows you to save the trace data into local memory ONLY. It also activates the auto file naming editor and automatically saves the current trace data with a name that is consecutive to name of the latest saved file.

This mode does NOT allow you to edit the file name. For example, if the previously saved file name is “Chicago\_site1”, the current trace data will be automatically named as “Chicago\_site2”.

- Pressing [**Save**] > {**Save Data as**} allows you to:
  - select a destination where a trace data is saved:  
Local or USB.
  - edit a user defined file name.  
See “[Editing a file name](#)” on page 44.



## Save an instrument setup

The tester will save instrument setups to the local memory. The maximum number of instrument setups that can be saved is 15.

Pressing **[Save] > {Save Setup}** saves the current instrument settings to the tester's local memory. The tester will record the following instrument settings:

- calibration mode  
records FullSpan or SelectedSpan calibration mode.
- measurement mode  
records measurement modes with their ancroyrn: RL, SWR, CL, DTF-RL, or DTF-SWR.
- parameters  
records frequency/distance range, and date and time. Limit lines, if activated, will be saved using Save Setup.

## Copy a screen

The Agilent N9330B offers two methods to copy a screen:

- Press **[PRT SCR]** to get a quick screen capture and save the file onto an external USB memory stick ONLY. Pressing the button also activates the auto file naming editor and automatically saves the screen shot with a name that is auto-sequential to the number of the latest saved file, from 1 to 65533.
- Pressing **[Save] > {Copy Screen}** allows you to save a screen shot into local memory or external USB memory stick that will be automatically assigned with a default file name, from 1 to 10.

**NOTE**

Insert a memory stick into the USB connector before copying screen.

## 4 Using Functions

Both of the methods allow you to save the currently displayed screen in JPEG format. Each screen copied is an 8-bit colored,  $640 \times 480$  resolution graph. Copy screen will include any limit lines, if shown on screen. However, a screen shot is not editable.

### Editing a file name

A valid file name may consist of capitalized letters (A to Z), decimal numbers (0 to 9), and symbols (dot and underscore).

Pressing **[Save]** > **{Save Data as}** accesses a dialog box with the last file name used. Press **[ESC/CLR]** to erase the current file name, before editing or creating a new file name.

**Input a new file name** Use the numerical keypad to input characters, numbers, and symbols.

- A single press on a numerical button inputs a decimal number.
- Consecutive press on a numerical button selects a letter or symbol.

### Recall a trace data

To recall a trace data perform the following steps:

- 1 Pressing **[Recall]** > **{Recall Data}** accesses a dialog box for selecting the trace data to be recalled.
- 2 Rotate the knob to select a trace data.
- 3 Press **[ENTER]** hardkey to confirm the selection.

Trace data can be deleted from the trace data list in local memory by:

- Press **{Delete Trace}** softkey to delete a trace data.
- Press **{Delete All}** to delete all the trace data from the list.

## Recall an instrument setup

The following steps show the steps to recall a stored instrument setup:

- 1 Press **[Recall]** > **{Recall Setup}** to bring up a dialog box for selecting which instrument setup is to be recalled.
- 2 Rotate the knob to select the desired trace data.
- 3 Press the **[ENTER]** hardkey to confirm your selection.

# Viewing system statistics

## Check system status

Pressing **[SYS] > {More} > {Status}** shows the primary information and current status of the tester, including:

- mode number, current firmware version, product serial number, main board serial number, and option status.
- current calibration mode and status, calibration temperature range, current internal temperature, current main battery capacity, and external power input status.

## Running a self test

Pressing **[SYS] > {More} > {Self Test}** triggers the tester to run a self test on the following items:

- Temperature
- RTC battery voltage
- RF PLL
- LO PLL

## Some Helpful Hints

### Preset the tester

Pressing the green button (the **[Preset]** hardkey) returns the tester parameters/settings to a known default state.

#### **N9330B Default Settings**

| Settings                    | Default                              |
|-----------------------------|--------------------------------------|
| measurement mode            | return loss (vs.freq)                |
| start frequency             | 25 MHz                               |
| stop frequency              | 4000 MHz                             |
| signal standard             | custom                               |
| start distance              | 0 m                                  |
| stop distance               | 9 m                                  |
| calibration mode            | SelectedSpan                         |
| calibration status          | Uncalibrated                         |
| calibrator indicator        | mechanic                             |
| trace resolution            | 521 point                            |
| marker(s)                   | all Off                              |
| single/multiple limit(s)    | all Off                              |
| limit beep                  | Off                                  |
| active [FREQ/DIST]          | FREQ                                 |
| active [HOLD/RUN]           | RUN                                  |
| single sweep                | Off                                  |
| IIM (interference immunity) | Off                                  |
| velocity factor             | 0.5                                  |
| windowing                   | none                                 |
| unit                        | meter                                |
| language                    | Depends on previous language setting |
| date format                 | YYYY-MM-DD                           |

### Adjust amplitude scale

Adjusting the amplitude scale can improve the clarity and view ability of the amplitude of a trace. the following methods are for adjusting the amplitude scale:

- Pressing **[Auto Scale]** hardkey automatically adjust the amplitude scale to best fit the current trace view.
- Pressing **[AMPTD] > {Top}**, or **[AMPTD] > {Bottom}** manually set the amplitude scale.

### Using single sweep

Using single sweep allows you to get an isolated return loss signal. In a single sweep, the tester sweeps from the start to the stop frequency/distance for only one time, and holds the trace static.

Key access: **[MEAS/View] > {Single}**

### Enabling interference immunity

Other signals can interfere with Return Loss/SWR measurement. You can minimize the effect of the interference on the measurement by activating interference immunity in the tester.

Key access: **[MEAS/VIEW] > {IIM}**

#### NOTE

Use of interference immunity increases the measurement time. Interference immunity should be used if a known interference signal exists or the Return Loss/SWR measurement displays suspicious characteristics, such as a spike or rapid movements in the noise floor.

## Holding a measurement

The user may hold (pause) a measurement.

- Pressing **[HOLD/RUN]** hardkey pauses (holds) a measurement, and displays the last trace scan.
- Pressing the **[HOLD/RUN]** hardkey again will restart the measurement.

## Quick access to freq/dist setups

Pressing **[FREQ/DIST]** allows the user to quickly access to frequency or distance setup submenu:

- When the measurement mode is SWR, return loss or cable loss, pressing **[FREQ/DIST]** hardkey accesses a submenu for the frequency range configuration.
- When the measurement mode is DTF-SWR, or DTF-return loss, pressing **[FREQ/DIST]** hardkey accesses a submenu for distance and DTF measurement configuration.

## Connector Care

Connectors quality is a critical link for a precision measurement. RF connectors are manufactured to extremely precise tolerances and must be used and maintained with care to protect the measurement accuracy and repeatability.

Taking proper care of cables and connectors will protect your tester's ability to make accurate measurements. Inaccurate measurements often result of improper connections, dirty, or damaged connectors.

Worn, damaged, out of tolerance, or dirty connectors degrade the accuracy and repeatability of RF measurements.

### CAUTION

Always take proper electrostatic precautions before touching the center conductor of any connector, or cable that is connected to the tester.

### Repeatability

If two identical measurements are made with the tester, the differences in the measured data should be so small that they do not affect the value of the measurement. Connector repeatability may be a cause of poor measurement results. Connector repeatability problems may be affected by:

- Dirty or damaged connectors
- Connections that have been made without using proper torque techniques (this applies when connections to the tester have been removed, then reconnected).

### Extending the life of your cables and connectors

- Minimize the bending of test cables. A single sharp bend can damage a RF cable.
- Avoid repeated connection and disconnection of all RF cable connections.
- Do not bend cables at or near the RF connectors. This may affect the RF performance.
- Inspect all connectors for dirt, nicks, and other signs of damage or wear before connection. A bad connector can ruin a good connector instantly.
- Clean dirty connectors. Dirt and foreign matter can cause poor electrical connections, affect RF measurements, and may permanently damage the connectors.

#### CAUTION

Never exceed the recommended connector torque values when attaching cables or damage may result.

Proper Connector Torque

| Connector | Torque<br>cm-kg | Torque<br>N-cm | Torque<br>in-lbs |
|-----------|-----------------|----------------|------------------|
| Type-N    | 52              | 508            | 45               |
| 3.5 mm    | 9.2             | 90             | 8                |
| SMA       | 5.7             | 56             | 5                |



## Using signal standards

There are 88 signal standards available in the tester. They can be accessed and selected for use in measurement setups.

The following is a list of common signal standards with their uplink, downlink and full span ranges.

| <b>Signal Standard</b>                | <b>Start freq.<br/>(MHz)</b> | <b>Stop freq.<br/>(MHz)</b> |
|---------------------------------------|------------------------------|-----------------------------|
| Bluetooth US/Europe uplink            | 2400.0                       | 2484.0                      |
| Bluetooth US/Europe downlink          | 2400.0                       | 2484.0                      |
| Bluetooth US/Europe full band         | 2400.0                       | 2484.0                      |
| Bluetooth Japan uplink                | 2472.0                       | 2497.0                      |
| Bluetooth Japan downlink              | 2472.0                       | 2497.0                      |
| Bluetooth Japan full band             | 2472.0                       | 2497.0                      |
| C 450 P uplink                        | 453                          | 464                         |
| C 450 P downlink                      | 463                          | 474                         |
| C 450 P fullband                      | 453                          | 474                         |
| C 450 SA uplink                       | 465                          | 470                         |
| C 450 SA downlink                     | 455                          | 460                         |
| C 450 SA fullband                     | 455                          | 470                         |
| CDMA China 12 uplink                  | 872                          | 915                         |
| CDMA China 12 downlink                | 917                          | 960                         |
| CDMA China 12 fullband                | 872                          | 960                         |
| Cellular uplink                       | 824                          | 849                         |
| Cellular downlink                     | 869                          | 894                         |
| Cellular fullband                     | 824                          | 894                         |
| Cellular 700 MHz uplink               | 776                          | 794                         |
| Cellular 700 MHz downlink             | 746                          | 764                         |
| Cellular 700 MHz fullband             | 746                          | 794                         |
| DCS GSM 1800 uplink                   | 1710                         | 1785                        |
| DCS GSM 1800 downlink                 | 1805                         | 1880                        |
| DCS GSM 1800 fullband                 | 1710                         | 1880                        |
| Digital Multimedia Broadcasting (DMB) | 2592.5                       | 2692.5                      |
| GSM 900 uplink                        | 880                          | 915                         |

## 4 Using Functions

| <b>Signal Standard</b>           | <b>Start freq.<br/>(MHz)</b> | <b>Stop freq.<br/>(MHz)</b> |
|----------------------------------|------------------------------|-----------------------------|
| GSM 900 downlink                 | 925                          | 960                         |
| GSM 900 fullband                 | 880                          | 960                         |
| IEEE 802 11 FH uplink            | 2402                         | 2495                        |
| IEEE 802 11 FH downlink          | 2402                         | 2495                        |
| IEEE 802 11 FH fullband          | 2402                         | 2495                        |
| IEEE 802 11 DS uplink            | 2412                         | 2484                        |
| IEEE 802 11 DS downlink          | 2412                         | 2484                        |
| IEEE 802 11 DS fullband          | 2412                         | 2484                        |
| IEEE 802 11 B G uplink           | 2400                         | 2484                        |
| IEEE 802 11 B G downlink         | 2400                         | 2484                        |
| IEEE 802 11 B G fullband         | 2400                         | 2484                        |
| IMT 2000 UMTS WCDMA uplink       | 1920                         | 1980                        |
| IMT 2000 UMTS WCDMA downlink     | 2110                         | 2170                        |
| IMT 2000 UMTS WCDMA fullband     | 1920                         | 2170                        |
| ISM 2 4 GHz uplink               | 2400                         | 2484                        |
| ISM 2 4 GHz downlink             | 2400                         | 2484                        |
| ISM 2 4 GHz fullband             | 2400                         | 2484                        |
| JTACS/NTAC Japan ARIB uplink     | 887                          | 925                         |
| JTACS/NTAC Japan ARIB downlink   | 832                          | 870                         |
| JTACS/NTAC Japan ARIB fullband   | 832                          | 925                         |
| NMT 411 uplink                   | 411                          | 420                         |
| NMT 411 downlink                 | 421                          | 430                         |
| NMT 411 fullband                 | 411                          | 430                         |
| NMT 450 uplink                   | 450                          | 460                         |
| NMT 450 downlink                 | 460                          | 470                         |
| NMT 450 fullband                 | 450                          | 470                         |
| NMT 450 20 kHz CDMA2000 uplink   | 451                          | 484                         |
| NMT 450 20 kHz CDMA2000 downlink | 461                          | 494                         |
| NMT 450 20 kHz CDMA2000 fullband | 451                          | 494                         |
| NMT 450 25 kHz CDMA2000 uplink   | 411                          | 458                         |
| NMT 450 25 kHz CDMA2000 downlink | 421                          | 468                         |
| NMT 450 25 kHz CDMA2000 fullband | 411                          | 468                         |
| NMT 900 MATS E uplink            | 890                          | 915                         |
| NMT 900 MATS E downlink          | 935                          | 960                         |

| <b>Signal Standard</b>  | <b>Start freq.<br/>(MHz)</b> | <b>Stop freq.<br/>(MHz)</b> |
|-------------------------|------------------------------|-----------------------------|
| NMT 900 MATS E fullband | 890                          | 960                         |
| PCS GSM 1900 uplink     | 1850                         | 1910                        |
| PCS GSM 1900 downlink   | 1930                         | 1990                        |
| PCS GSM 1900 fullband   | 1850                         | 1990                        |
| PCS Korea uplink        | 1750                         | 1780                        |
| PCS Korea downlink      | 1840                         | 1870                        |
| PCS Korea fullband      | 1750                         | 1870                        |
| PDC 800 uplink          | 898                          | 940                         |
| PDC 800 downlink        | 843                          | 885                         |
| PDC 800 fullband        | 843                          | 940                         |
| PDC 1500 uplink         | 1525                         | 1549                        |
| PDC 1500 downlink       | 1477                         | 1501                        |
| PDC 1500 fullband       | 1477                         | 1549                        |
| PHS uplink              | 1895                         | 1918                        |
| PHS downlink            | 1895                         | 1918                        |
| PHS fullband            | 1895                         | 1918                        |
| SMR 800 uplink          | 806                          | 821                         |
| SMR 800 downlink        | 851                          | 866                         |
| SMR 800 fullband        | 806                          | 866                         |
| SMR 1500 uplink         | 1453                         | 1465                        |
| SMR 1500 downlink       | 1501                         | 1513                        |
| SMR 1500 fullband       | 1453                         | 1513                        |
| TACS/ETACS uplink+C22   | 872                          | 915                         |
| TACS ETACS downlink     | 917                          | 960                         |
| TACSETACS fullband      | 872                          | 960                         |
| Tetra uplink            | 380                          | 430                         |
| Tetra downlink          | 380                          | 430                         |

### Using cable folder

In DTF measurement, you are required to input the velocity factor and the average cable loss (dB/m). In case that you do not remember the velocity factor and the average cable loss of the cable-under-test, use the cable folder to find the cable type.

When you are making a DTF measurement, pressing **{Cable}** brings up a dialog box for frequency band selection first. You should select any of the following categories:

- Standard (measure in 1000 MHz)
- Standard (measure in 2000 MHz)
- Standard (measure in 2500 MHz)
- Customized cables

Press **[ENTER]** to confirm the selection. Then the tester displays a cable list in the frequency band. Each category of cables is listed with cable type velocity factor and average cable loss.

If you wish to create customized cable library, you need to use *N9330B Post Analysis Tool* to send the customized cable list to the tester.

## System Setups

### Setting screen resolution

Three types of screen resolution choices are available:

- 521
- 261
- 131

The higher resolution you set, the more precise trace you get, but longer sweep time you need to spend.

Key access: [MEAS/VIEW] > {Resolution}

### Setting power manager

The tester will turn off the LCD screen and key light after non-use of from 1 minute to 60 minutes, user defined by pressing {Edit}, if power manager is turned on.

#### NOTE

The edited length of time will be noneffective if Power Manager is set to "off " that the tester will turn off the display and lights never after the defined idle time.

---

Key access: [SYS] > {Power Manager}

### Choosing a unit

Two types of distance units are available:

- meter
- foot

Key access: [SYS] > {Units}

The change of unit is displayed at the left lower corner of the screen.

### Setting date and time

Key access: **[SYS] > {Clock}**

The date and time display on the top line of the screen.

### Firmware upgrade

The N9330B provides an easy and fast access for firmware update.

**NOTE**

When updating firmware, make sure there will be a constant power supply for at least 10 minutes.

---

Refer to the following steps to upgrade the firmware:

- 1 Download firmware upgrade package from website.
- 2 Extract and copy *N9330B.bin* file to the ROOT directory of USB memory stick.
- 3 Insert this USB stick to the USB port on the top panel of N9330B.
- 4 Press **{SYS} > {Upgrade}** to upgrade the firmware.
- 5 Cycle the power to N9330B when notice "Upgrade Complete. Effective after Restart."

**NOTE**

When upgrade N9330B firmware from some old version, unrecognized fonts will be displayed instead of this message. please restart N9330B as well.

---

- 6 When unit powered on, press **{SYS} > {More} > {Statues}** to check the firmware version.

### Key light setting

The key light of the tester can be turned on or be turned off. The choice is based on personal preference or using conditions.

Key access: **[SYS] > {More} > {Key Light}**

## Setting the brightness of key light

The user can **adjust the brightness of key light** for different conditions.

Key access: **[SYS] > {More} > {More} > {Key Light Edit}**

## Light Setting

The N9330B offers two brightness adjusting modes. Addressing “Auto” for adjusting brightness automatically by the light sensor, while “Man” for adjusting by manually operation.

Key access:

**[SYS] > {More} > {More} > {More} > {Light Set}**

## 4 Using Functions





Agilent N9330B  
Handheld Cable & Antenna Tester

## 5 Key Reference



### AMPTD

Sets the displayed amplitude range. Use the numerical keypad to input the amplitude value or rotate the knob to increase or decrease the amplitude value.

The tester saves the previous modified amplitude range and recalls it when the tester is powered on.

The displayed amplitude range is different when the tester is in different mode:

- Return loss  
In this mode, the default unit dB does not display on the screen.
- Cable loss  
In this mode, the default unit dB does not display on the screen.
- SWR (Standing Wave Ratio)
- DTF\_Return loss  
In this mode, the default unit dB does not display on the screen.
- DTF\_SWR

### Top

Sets the displayed top amplitude value.

Tester will automatically revise your input by a minimum amplitude increment, if you previously input an improper top amplitude.

Key access: **[AMPTD] > {Top}**

## Bottom

Sets the displayed bottom amplitude.

Tester will automatically revise your input by a minimum amplitude increment, if you previously input improper bottom amplitude.

Key access: [AMPTD] > {Bottom}

### CAUTION

Damage to the tester may result when the input power is greater than +23 dBm or 50 VDC.

---

# CAL

Activates the calibration process for the tester. A calibration process performs open, short and load (OSL) calibrations. You can either follow the instructions from the tester to run a calibration or customize a calibration.

You can select either an electronic calibrator or a T-combo mechanical calibrator to perform an open-short-load calibration.

- **T-combo calibrator**

Is a T-shaped mechanical calibrator. The three parts of the T-combo are the open, short and 50  $\Omega$  load. The T-combo calibrator is a more accurate calibration than the electronic calibrator and will improve the measurement range of the tester.

- **Electronic calibrator**

The electronic calibrator enables you to perform a one-connection calibration process. It performs an open, short, and 50  $\Omega$  load calibration consecutively. The electronic calibrator is faster but less accurate than the mechanical calibrator.

When a calibration is completed, a “Calibrated” indicator displays on the left top corner the screen.

Refer to [“Calibrate the N9330B before making measurements”](#) on page 25, for more information.

## Bypass Electronic Calibrator

The electronic calibrator is the default setting for the tester. However, a user may choose to use either the to electronic calibrator, or T-combo mechanical calibrator.

When using the T-combo mechanical calibrator, the user will bypass the default electronic calibrator process by pressing **[CAL] > {Bypass E Calib}**. The tester will then access the manual open-short-load calibration.

Key access: **[CAL] > {Bypass E Calib}**

## User Cal Mode

The user may define a custom calibration process instead of using the tester default, open-short-load combination. Pressing **[Cal] > {User Cal Mode}** to select the calibration item for your customized calibration.

**NOTE**

User defined calibration accepts only the T-combo calibrator. The electronic calibrator is not compatible with any user defined calibration mode. A User Cal requires the user to perform an open-short-load calibration process.

---

Key access: **[CAL] > {User Cal Mode}**

## Distance

When you are using the DTF (Distance to Fault) mode, pressing [**FREQ/DIST**] brings up a submenu of setting DTF parameters, instead of frequency range. The tester saves the latest defined DTF parameters and recalls them when you power on the tester next time.

### Start

Sets the displayed start distance. You can pre-define the default unit to be either meters or feet by pressing [**SYS**] > {Units}. The minimum distance increment is 0.1 m or 0.1 foot.

Key access: {**Start**}

### Stop

Sets the displayed stop distance. Stop distance is always greater than the start distance. The maximum stop distance is calculated from the following equation:

$$(\text{Resolution} * 150 * V_t/V_c) / (F_2 - F_1)$$

In this equation,

- Resolution means the current resolution of the trace. Pressing [**MEAS/VIEW**] > {Resolution} enables you to select resolution setups: 131, 261 or 521 points.
- $V_t/V_c$  means the velocity factor of a cable.
- $V_c$  means velocity of light.
- $F_2$  means the stop frequency and  $F_1$  refers to the start frequency. The offset between  $F_2$  and  $F_1$  should always be greater than a tenth of current resolution (Resolution/10). For example, if the current resolution is 521, then  $F_2 - F_1$  should be greater than 52.1 MHz.

Key access: {**Stop**}

## DTF Config

Lists and edits the DTF parameters.

Key access: **{DTF Config}**

Pressing **{DTF Config}** brings up a check list, showing the parameters in a DTF measurement:

- **Start Distance**  
When you rotate knob to highlight this parameter and press **[ENTER]**, the displayed start distance becomes editable. This is equivalent to pressing **[FREQ/DIST] > {Start}** in DTF mode.
- **Stop Distance**  
When you rotate knob to highlight this parameter and press **[ENTER]**, the displayed stop distance becomes editable. This is equivalent to pressing **[FREQ/DIST] > {Stop}** in DTF mode.
- **Start Frequency**  
When you rotate knob to highlight this parameter and press **[ENTER]**, the start frequency becomes editable. This is equivalent to pressing **[FREQ/DIST] > {Start}** when in non-DTF mode.  
Changing frequency range changes the maximum measured and displayed distance.
- **Stop Frequency**  
When you rotate knob to highlight this parameter and press **[ENTER]**, the stop frequency becomes editable. This is equivalent to pressing **[FREQ/DIST] > {Stop}** when in non-DTF mode.  
Changing frequency range changes the maximum measured and displayed distance. Refer to "[Distance](#)" on page 64, for more information.
- **Resolution**  
When you rotate knob to highlight this parameter and press **[ENTER]**, the trace resolution becomes editable. This is equivalent to pressing **[Meas/View] > {Resolution}**. Changing the resolution changes the maximum measured and displayed distance.

- **Windowing**  
When you rotate knob to highlight this parameter and press **[ENTER]**, the windowing menu is presented. This is equivalent to pressing **{Window}** in DTF mode.
- **Cable**  
When you rotate knob to highlight this parameter and press **[ENTER]**, a cable library is brought up. This is equivalent to pressing **{Cable}** in DTF mode.
- **Velocity Factor**  
When you rotate knob to highlight this parameter and press **[ENTER]**, the velocity factor becomes editable. This is equivalent to pressing **{Velocity Factor}** in DTF mode.
- **Cable Loss**  
When you rotate knob to highlight this parameter and press **[ENTER]**, the cable loss becomes editable. This is equivalent to pressing **{Cable Loss}** in DTF mode.

### Cable Loss

Sets the average loss of a transmission cable, with minimum increment is 0.001. Use either dB/m or dB/foot as its unit.

Key access: **{Cable Loss}**

### Velocity Factor

Sets the velocity factor of a transmission cable. Velocity factor has no unit. It refers to the rate of a signal's transmission speed in a particular cable versus its transmission speed in vacuum. Velocity factor ranges from 0.01 to 1.

Key access: **{Velocity Factor}**



## Cable

The cable library consists of four categories of cables:

- Standard cables below 1000 MHz
- Standard cables below 2000 MHz
- Standard cables below 2500 MHz
- Customized cables

Key access: **{Cable}**

In each category, commonly used cables are listed with cable type, velocity factor, and cable loss. If you need to customize cables, use the *N9330B Post Analysis Tool* (PC software) to send customized cable list to the tester.

## Window

- Adds window to traces. Five options of windowing include:
  - Rectangular windowing
  - Hamming windowing
  - 3-sample Blackman windowing
  - 4-sample Blackman windowing
  - None

Key access: **{Window}**

## Enter and ESC/CLR

[ENTER] and [ESC/CLR] are the frequently used keys on the tester.

### Enter

- Terminates date entry and enters into the analyzer a numerical value keyed from numeric keypad on the front panel.
- Terminates filename entries.

Key access: [ENTER]

### ESC/CLR

- Clears data entries.
- Exits from a functional block.

Key access: [ESC/CLR]

## Frequency

Sets the measurement frequency range. The default unit is MHz and the tester provides this unit only. The tester saves the latest defined frequency range and recalls the frequency setup when you power on the tester next time.

### Start

Sets the start frequency. The minimum increment is 0.1 MHz. Use numerical keypad to input the frequency and press **[ENTER]** to confirm your input. Or rotate the knob to increase or decrease the frequency. You can also press **{Left}** or **{Right}** to move the cursor to the digit you want to edit on, then rotate the knob to modify the value.

Key access: **[FREQ/DIST] > {Start}**

### Stop

Sets the stop frequency. The minimum increment is 0.1 MHz.

Key access: **[FREQ/DIST] > {Stop}**

## Signal Standard

Includes a frequency range list of several signal standards. When you select a signal standard from the list, the tester automatically sets the start and stop frequency according to the frequency of the signal standard you just selected. Refer to [“Using signal standards”](#) on page 51 for more information.

Key access: **[FREQ/DIST] > {Signal Standard}**

#### NOTE

When in DTF mode, pressing **[FREQ/DIST]** brings up a submenu of setting the distance range, instead of frequency range.

### Limit

Sets the pass/fail bar for traces. Two individual single limit lines and single limit line with five multiple limit segments are selectable. The tester also provides a limit beep function to alert a failure of limit judgement. If traces are below a limit or a limit segments, the tester judges the measurement as “passed”, if the traces are above the limit bars, the tester judges the measurement as “failed”.

#### Limit 1

Pressing [**LIMIT**] > {**Limit 1**} brings up a sub menu for editing a single limit applied horizontally across the displayed bandwidth.

The amplitude range of a single limit varies according to the current measurement mode. Refer to “**AMPTD**” on page 60 for more information.

Key access: [**LIMIT**] > {**Limit 1**}

#### Limit 2

Pressing [**Limit**] > {**Limit 2**} brings up a sub menu for editing a single limit that applies a second horizontal limit line across the displayed bandwidth.

The amplitude range of a single limit varies according to the current measurement mode. Refer to “**AMPTD**” on page 60 for more information.

Key access: [**LIMIT**] > {**Limit 2**}

## Multiple Limit

Pressing **{Multi Limit}** brings up a submenu for editing multiple limit segments. Up to five individual limit segments may be applied. Each segment requires a defined frequency and amplitude value of the start and end point for the segment.

**NOTE**

Limit segments may not overlap with each other and segments must have a horizontal component, that is. they cannot be vertical.

---

Key access: **[LIMIT] > {Multi Limit}**

## Limit Beep

The tester emits a beeping sound when the trace is above the limit bar to indicate the measurement fails as defined in the limit setups.

Key access: **[LIMIT] > {Limit Beep}**

### Marker

Provides frequency and amplitude readout for a particular point or multiple points on a trace. The tester provides 6 markers, with 6 different colors. You can turn on or off any one of them, or turn off all of them at the same time.

Marker readout displays at the lower side of the screen, in a format of (frequency, amplitude). The tester always uses MHz as its default frequency unit and dB as its default amplitude unit except for SWR measurement.

#### Marker 1...6

Provides editable markers, labeled from Marker1 to Marker6. Two methods of placing a marker onto a particular point on a trace:

- Turn on a marker and rotate the knob to move the marker to the point.
- Turn on a marker and press **[Edit]** to manually set the marker to a specified point.

Key access: **[MARKER] > {Marker 1...6} > {Edit}**

#### Delta

Calculates and reads out the frequency and amplitude offsets of Markers, comparing to Marker1. When using delta function, the tester keeps the marker on the trace as it is, but the readout changes to the frequency and amplitude offsets comparing to the Marker1.

Key access: **[MARKER] > {Marker 2...6} > {Delta}**

#### Marker to Peak

Places a marker to the point that has the highest amplitude on the trace.

Key access: **[MARKER] > {Marker 1...6} > {Marker to Peak}**

### **Marker to Minimum**

Places a marker to the point that has the lowest amplitude on the trace.

Key access:

**[MARKER] > {Marker1...6} > {Marker to Minimum}**

### **Marker All off**

Turn off all the active markers.

Key access: **[MARKER] > {Marker All off}**

### Meas/View

Five functional blocks are available under **[MEAS/VIEW]**:

- Setting the trace resolution
- Enabling the single sweep
- Performing mathematical operation on two traces
- Performing trace overlap comparison
- Enabling interference immunity

### Resolution

Three types of trace resolution are selectable:

- 131 points
- 261 points
- 521 points

Key access: **[MEAS/VIEW] > {Resolution}**

### Single

Toggles the single sweep between on and off. When single sweep is off, the tester sweeps continuously.

Key access: **[MEAS/VIEW] > {Single}**

### IIM (Interference Immunity)

Toggles the interference immunity between on and off. When IIM is on, the sweep speed becomes slower than normal.

Key access: **[MEAS/VIEW] > {IIM}**



## Trace Operation

Mathematically compares current trace with a pre-stored trace. Trace operation requires both measurements be made using the same parameters, mode, resolution, and frequency/distance range.

Pressing **{Trace Operation}** brings up a check box for you to choose a trace operation mode:

- Off  
The tester turns off trace operation function.
- Trace – Memory  
Current trace subtracts pre-stored trace.
- Trace + Memory  
Current trace adds pre-stored trace.

Key access: **[MEAS/VIEW] > {Trace Operation}**

## Trace Overlap

Overlaps currently displayed measurement trace with a previously-stored trace, using a different color. Trace Overlap requires both measurements be made using the same parameters, mode, resolution, and frequency/distance range.

Key access: **[MEAS/VIEW] > {Trace Overlap}**

### Mode

Accesses the check box menu for selecting the measurement mode from the following five options:

- Standing wave ratio (SWR)
- Return loss
- Cable loss
- Distance-to-Fault (DTF)
  - Standing wave ratio
  - Return loss

Key access: **[MODE]**

## System

Personalizes the tester and manages system setups.

### Cal Mode

Toggles calibration mode between full span calibration and selected span calibration.

Key access: **[SYS] > {Cal Mode}**

### Power Manager

Pressing **[SYS] > {Power Manager (on)}** enables the power saving mode. The tester will turn off the LCD screen and key light after non-use of from 1 minute to 60 minutes, user defined by pressing **[SYS] > {Power Manager} > {Edit}**. Pressing any key on the front panel, except the power switch, brings the tester back to its previous state immediately.

Key access: **[SYS] > {Power Manager}**

### Units

Toggles the default setting unit of distance between meter and foot.

Key access: **[SYS] > {Units}**

### Language

Enables you to select a regional language displayed on the screen. Choices are: English, French, German, Italian, Spanish, Portuguese, Russian, Korean, Japanese, Simplified Chinese and Traditional Chinese.

Key access: **[SYS] > {Language}**

### Clock

Accesses the date and time settings.

Key access: **[SYS] > {Clock}**

### Upgrade

Enables the firmware upgrade process.

- 1 Copy the upgrade application onto the root level of a USB memory stick.
- 2 Insert the USB memory stick into the USB interface of the tester on its top panel.
- 3 Press **[SYS] > {Upgrade}** to initiate firmware upgrade.
- 4 The tester will promote a message to indicate firmware upgrading is in process.
- 5 After upgrading completes, power off the tester then reboot it.

Key access: **[SYS] > {Upgrade}**

### Status

Shows the systematic information of the tester.

Key access: **[SYS] > {Status}**

### Self Test

Runs a self test on temperature and hardware.

Key access: **[SYS] > {Self Test}**

### E Calib Test

Verifies the communication between the electronic calibrator and the tester.

Key access: **[SYS] > {E Calib Test}**

### Intelligent

Toggles the ability to identify the calibration loads (Open/Short/Load) from each other between on and off.

Key access: **[SYS] > {Intelligent}**

## Fast Meas

Toggles the fast sweep between on and off.

Key access: [SYS] > {Fast Meas}

## License key

Brings up a window for inputting a license code for an option.

Key access: [SYS] > {License key}

## Key Light

The key light of the tester can be turned on or be turned off resting with using conditions.

Key access: [SYS] > {Key Light}

## Key Light Edit

The brightness of the key light can be adjusted based on personal preference.

Key access: [SYS] > {Key Light Edit}.

## Light Set

The Agilent N9330B provides two brightness adjusting modes. Addressing “**Auto**” for adjusting brightness automatically by the light sensor, while “**Man**” for manually operation.

Key access: [SYS] > {Light Set}

## 5 Key Reference



Agilent N9330B  
Handheld Cable and Antenna Tester

## 6 Instrument Messages



## Error Message List

| Error Code | Error Message                          | Description   |
|------------|--|---|
| -310       | System error                           | Failed to write to file.                            |
| -311       | System error                           | Failed to load system file.                         |
| -312       | System error                           | Failed to delete file.                              |
| -313       | System error                           | Failed to read file.                                |
| -314       | System error                           | Failed to save file.                                |
| 525        | Read Ext. power voltage error          | Failed to read Ext. power voltage.                  |
| 526        | RTC battery low voltage                | RTC battery Low voltage.                            |
| 527        | Read RTC battery error                 | Failed to read RTC battery.                         |
| 528        | Read main battery error                | Failed to read main battery.                        |
| 529        | Temperature sensor communication error | Failed to temperature sensor communication.         |
| 530        | Read RTC time error                    | Failed to read RTC time.                            |
| 531        | Read Ecal serial number error          | Failed to read electronic calibrator serial number. |
| 701        | RF PLL error                           | RF PLL unlocked.                                    |
| 702        | LO PLL error                           | LO PLL unlocked.                                    |
| 703        | RF and LO error                        | RF and LO PLL unlocked.                             |



## Warning List

| No. | Warning Message   |
|-----|---|
| 1   | Open segment error. Overlapped with other segment(s). Continue in 3 seconds.          |
| 2   | Open segment error. The start is greater than the stop. Continue in 3 seconds.        |
| 3   | Edit segment error. The start is greater than the stop. Continue in 3 seconds.        |
| 4   | Edit segment error. Overlapped with other segment(s). Continue in 3 seconds.          |
| 5   | Trace operation error. Incompatible traces. Continue in 3 seconds.                    |
| 6   | Trace overlap error. Incompatible traces. Continue in 3 seconds.                      |
| 7   | Edit segment error. Segment cannot be vertical. Continue in 3 seconds.                |
| 8   | File name already exists, overwrite it? Press ENTER to overwrite. Press ESC to abort. |
| 9   | File name too long. Max. 20 char allowed. Press ENTER/ESC to abort.                   |
| 10  | Calibration invalid. Frequency changed. Continue in 3 seconds.                        |
| 11  | Calibration will be invalidated. Temperature out of range. Press ENTER/ESC to abort.  |
| 12  | Cannot open segment. Segment cannot be vertical. Continue in 3 seconds.               |
| 13  | Save file error. File name cannot be null. Press ENTER/ESC to abort.                  |

## 6 Instrument Messages

| No. | Warning Message   |
|-----|---|
| 14  | Save trace error. Memory is full. Continue in 3 seconds.                                |
| 15  | Cannot modify the value now Continue in 3 seconds.                                      |
| 16  | Changing CAL mode invalidates calibration. Press ENTER to continue Press ESC to abort.  |
| 17  | Changing frequency invalidates calibration. Press ENTER to continue Press ESC to abort. |
| 18  | Delete this trace? Press ENTER to continue. Press ESC to abort.                         |
| 19  | Delete all traces? Press ENTER to continue. Press ESC to abort.                         |
| 20  | Freq range is changed. BW is below min. BW. Continue in 3 seconds.                      |
| 21  | Cannot upgrade. There isn't application in the U-disk. Press ENTER/ESC to abort.        |
| 22  | Upgrade complete. Press ENTER/ESC to abort.   |

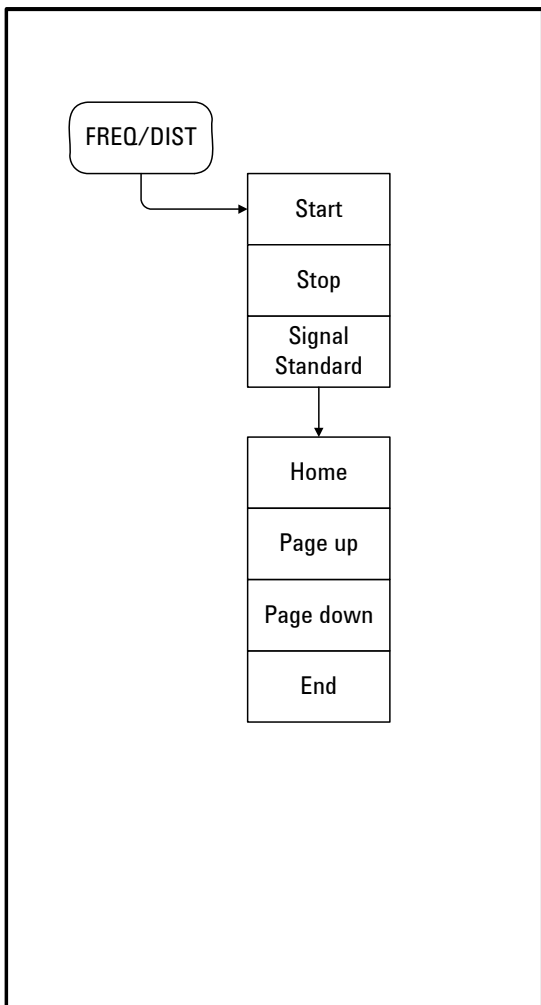


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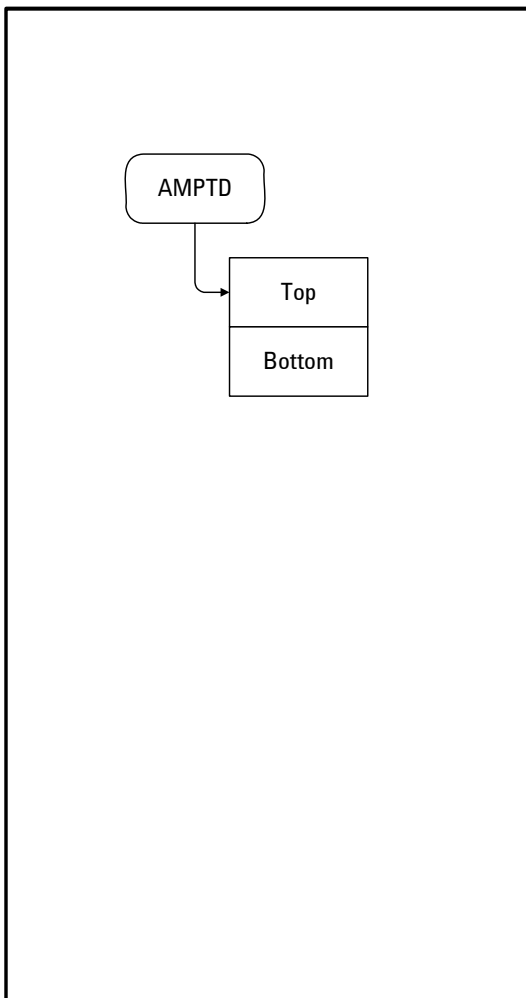
## 7 Menu Map



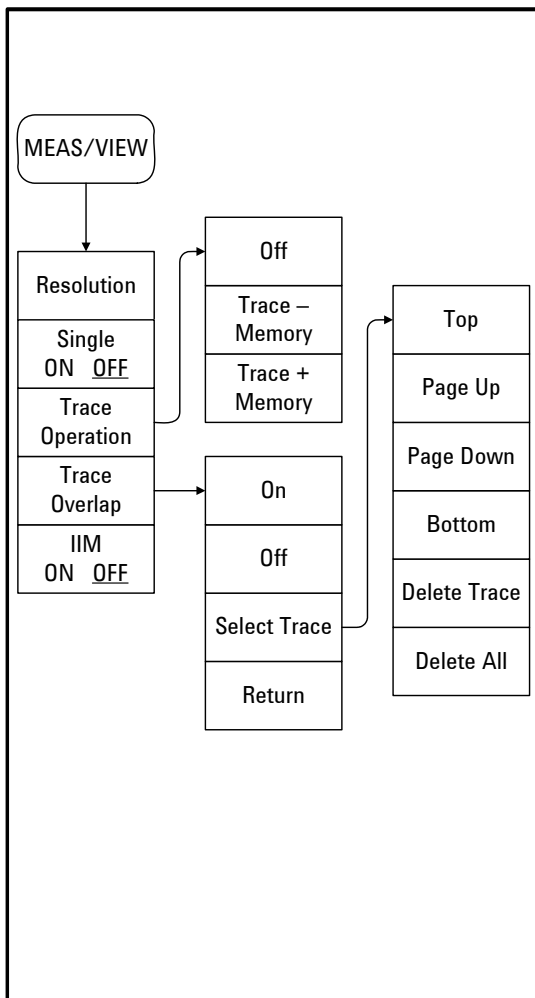
## FREQ/DIST



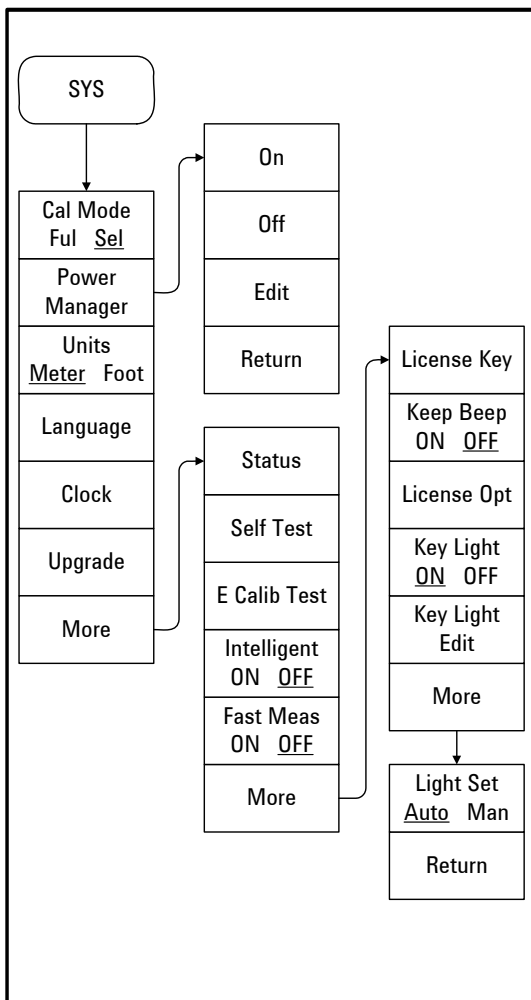
## AMPTD



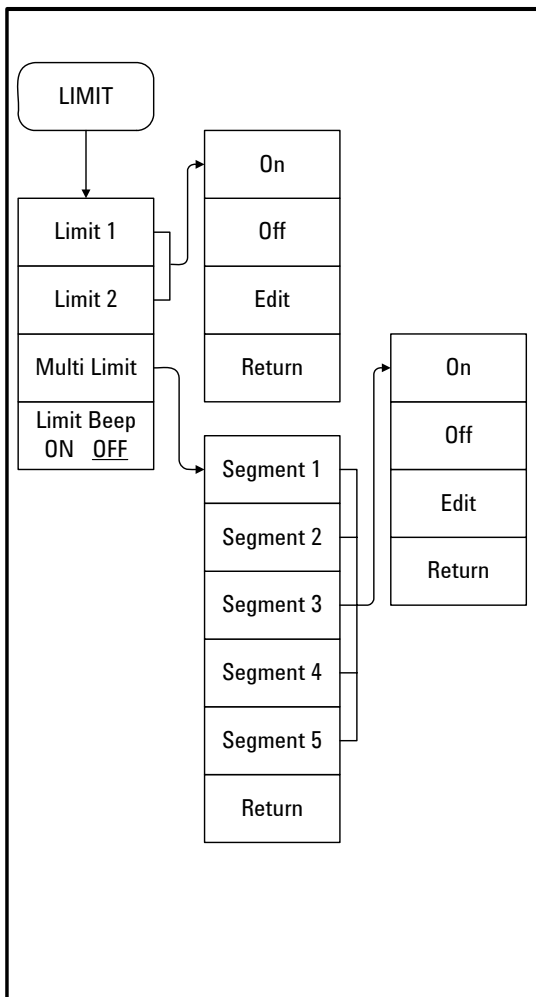
## MEAS/VIEW



## SYS

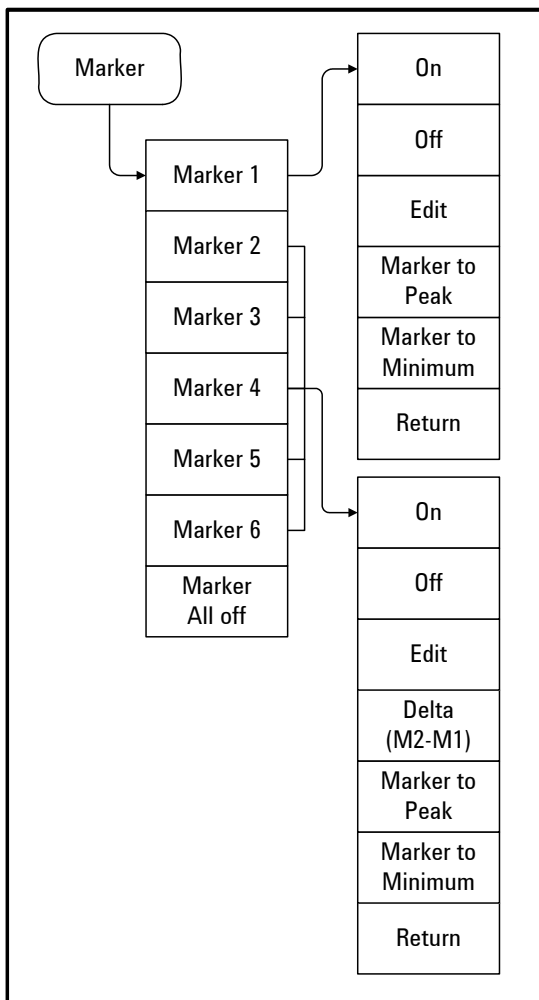


## LIMIT





## Marker



## **7 Menu Map**

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